

# CEMENT AND LIME MANUFACTURE

PUBLISHED ALTERNATE MONTHS.

PRICE 1/- A COPY.

ANNUAL SUBSCRIPTION 6s. POST FREE.

PUBLISHED BY  
CONCRETE PUBLICATIONS LIMITED  
14 DARTMOUTH STREET, LONDON, S.W.1

TELEPHONE: WHITEHALL 4561.

TELEGRAPHIC ADDRESS:  
CONCRETIV, PARL. LONDON.

PUBLISHERS OF  
"CONCRETE & CONSTRUCTIONAL ENGINEERING"  
"CONCRETE BUILDING & CONCRETE PRODUCTS"  
"CEMENT & LIME MANUFACTURE"  
"THE CONCRETE YEAR BOOK"  
"CONCRETE SERIES" BOOKS, ETC.

VOLUME XX. NUMBER 4

JULY, 1947

## Fifty Years of Mechanisation in the Cement Industry.

By G. PERCY TAYLOR, F.C.G.I., M.Inst.C.E.

(Formerly Chief Engineer, Associated Portland Cement Manufacturers, Ltd.)

AT the end of nearly fifty years with the Engineering Department of the Associated Portland Cement Manufacturers, Ltd., and the British Portland Cement Manufacturers, Ltd., and with one of the companies which was merged with the former company, it may be of interest to others if I briefly recall some of the methods and processes used in the industry before the mechanisation of recent years was embarked upon, and compare them with the methods used to-day.

The writer was first employed, in 1897, on the engineering staff of Messrs. Knight, Bevan & Sturge, who owned the works at Northfleet generally known as "Bevans." The reconstruction of this works covers practically the whole field of the reduction in labour requirements and the cheapening of the cost of cement by mechanisation from the beginning of this century.

Mechanisation has been applied to all departments, and the illustrations cover many operations, but the benefits are most marked in connection with the handling of clay, accessories of the rotary kiln, packing, and electric drives with purchased electricity. Bevans works has an excellent frontage on the river Thames, and even in those days controlled a very large supply of raw materials, which have since been added to from time to time. In 1900, when the Associated Company purchased the works, it was manufacturing by very old-fashioned methods, and although alterations were in contemplation these were naturally postponed when the sale of the business was in view.

When the Associated Company was formed in 1900 it had in hand the completion of sixteen rotary kilns at Swanscombe, two miles from Northfleet. This was the first installation of modern rotary kilns in England, and many difficult

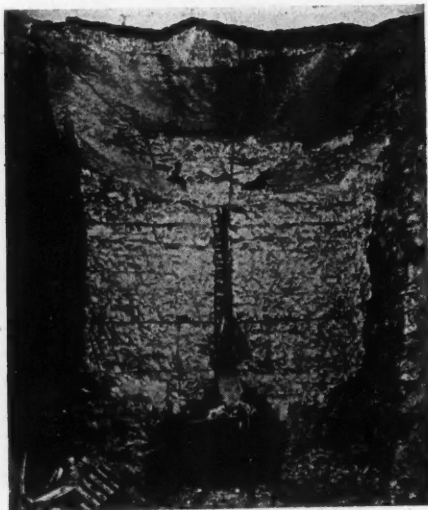


Fig. 1.—Quarrying Chalk Fifty Years Ago.

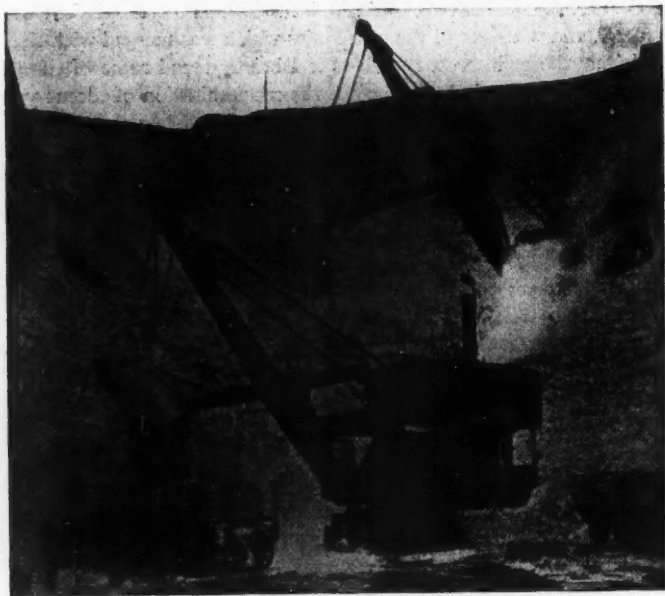


Fig. 2.—Steam Navvies Digging Chalk in Two Benches To-day.

problems had to be solved before its success was assured. As soon as this was completed it was natural that rotary kilns should be installed at Bevans works, and eight were authorised in June, 1903. These, originally 70 ft. long, were later lengthened to 130 ft., and four kilns of this length were added between 1906 and 1913. At that time the cost of electricity was high, and the washing and grinding plants were therefore retained as small units driven by separate steam engines, although new ball mills and tube mills were installed to replace the grindstones.

Twenty-one years later, in 1924, Bevans works became due for reconstruction again, and on this occasion the whole of the plant was new. The washmills were built in the quarry about a mile from the works, and the number of kilns was reduced from twelve 130 ft. long making 5,000 tons per week to four 250 ft. long



**Fig. 3.—Excavating Clay from Marshland (1897).**

making 10,000 tons per week. The whole of the grinding plant was concentrated in one building alongside the kilns. At the same time silos were built and packing machines were installed in conjunction with a jetty which was designed to accommodate ships drawing up to 26 ft. of water, so that cement could be loaded into ships directly instead of being taken away by barge for loading in the docks. The same jetty accommodates ships bringing in coal.

These notes are intended primarily to compare the conditions in 1897 with those now obtaining. It should be pointed out that photographs showing all the earlier processes used at Bevans works are not available, so that some of the illustrations are from photographs taken at other works of the Associated and British Companies.

#### **Quarrying Chalk.**

*Fig. 1* illustrates the method used at all quarries supplying works on the Thames in 1897. The faces of the quarries were generally about 80 ft. high and

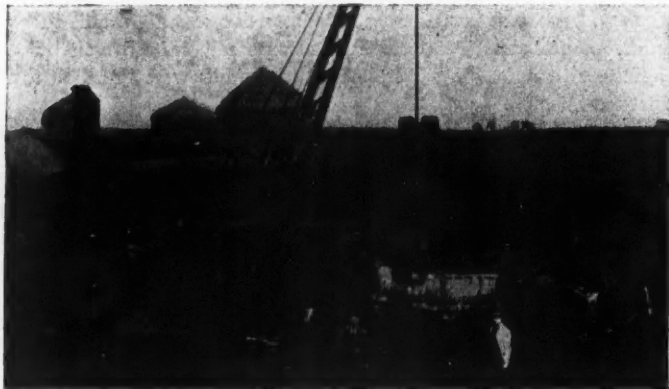


Fig. 4.—Crane and Grab used for Excavating Clay in Marshland (1900).



Fig. 5.—Digging Clay by Hand from Inland Deposit (1900).

short headings were driven into the bottom of the face. Except for the bottom 10 ft. the chalk had only to be loosened by picks or pitchers to fall into the trucks, and the effort of the chalk-getters was therefore reduced to a minimum. The wagons were marshalled by horses.

In comparison with this the modern excavator, lifting about three tons at a time, would do the work of about 100 men if it could be operated continuously. These excavators generally dig a face from 30 to 40 ft. high, and a face 100 ft. high would therefore have to be dug on three levels. When it is not convenient to get direct access to each level, the chalk from the upper levels is sometimes thrown

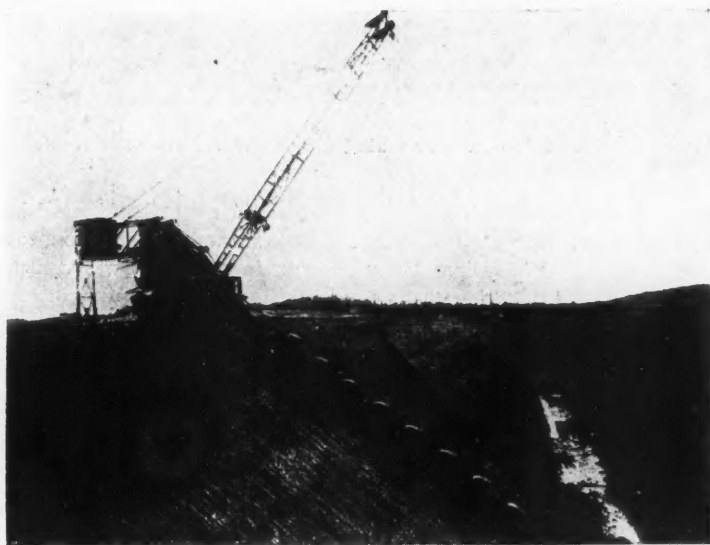


Fig. 6.—Continuous Bucket Excavator Digging Clay (1947).

down (*Fig. 2*) to be loaded into wagons by an excavator working on the floor of the quarry.

Owing to the necessity for making approach roads to several levels—or alternatively digging twice and throwing the chalk down from the upper level—and in view of the heavy capital cost involved, the financial saving arising from the use of excavators are moderate in comparison. On the other hand it would not be practicable by the old method to supply chalk to a works calling for, say, 3,000 tons of chalk a day.

#### Excavating and Handling Clay.

The methods of handling clay depend upon its source. It is generally obtained either from marshes where it is saturated with water, or inland from high ground where it is relatively dry. These two sources call for different methods.

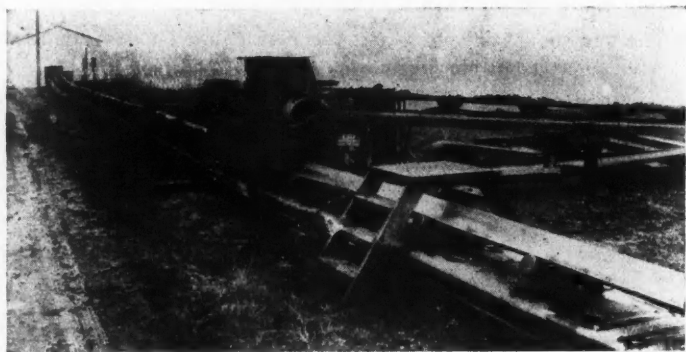


Fig. 7.—Belt Conveyor taking Clay to Washmills (1947).

In 1897 all the works on the Thames obtained their supplies from saltings in the Medway valley, that is, marshland outside the sea wall and therefore covered with water at high tide. This enabled the barges in which clay was transported to float in and sit on the bottom where the clay was to be dug, being guided by mark poles. The clay was dug by hand as illustrated in *Fig. 3*. This was very heavy work, and as the saltings were in most cases a considerable distance from a town or village it would certainly not be regarded as an attractive job to-day. The unloading of the barges at the works involved similar heavy work,

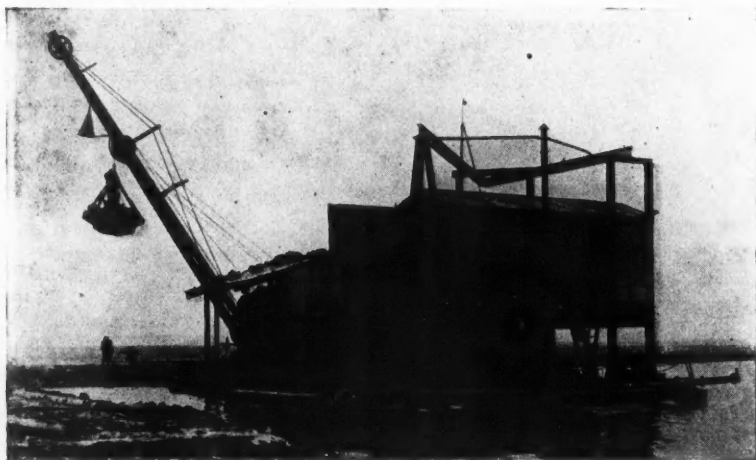
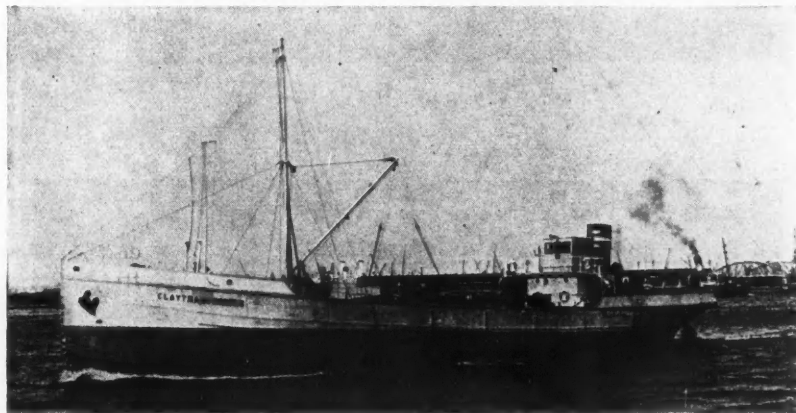


Fig. 8.—Clay Excavator and Washmill on Pontoon on Non-tidal Marsh (1947).

the clay being dug out of the barge by hand and thrown into buckets which were lifted by steam crane, tipped into wagons, and hauled by horses to the washmill. In some cases (though not at Bevans) clay has been obtained from marshes inside the sea wall near the works.

The first labour-saving machines installed were grabs for loading and unloading, and these involved the use of much heavier cranes. *Fig. 4* shows a crane and grab used in such circumstances for excavating from a marsh inside the sea wall. The excavations had to be kept dry by pumping, but the wagons could go directly to the washmills without additional handling.

Soon after 1900 a high-level inland deposit of clay was worked about a mile from Bevans works. This was at first dug by hand as illustrated in *Fig. 5* and washed on the site by mills driven by gas engines. The slurry was pumped



**Fig. 9.—Tank Vessel of 10,000 tons Capacity carrying Clay Slurry (1947).**

to the works. Since this deposit became exhausted similar clay is obtained from Cobham, about five miles inland. It is dug by an excavator with electric drive and the clay is washed with about 66 per cent. of water and pumped about five miles along the main Rochester road in two stages to the main washmills in the quarries. It is stored there in tanks with stirrers and sent in measured quantities to the main washmills where the chalk is added. The saving of labour in transport is remarkable.

At another works (at Grays, in Essex) the clay is dug on an inland site about two miles from the works. In this case the pit is emptied of water and the clay is dug by a continuous-bucket excavator (*Fig. 6*) and transported on belt conveyors (*Fig. 7*) to the washmills. The slurry is pumped directly into mixers (fitted with stirrers) at the works.

At this stage it may be interesting to refer to the methods used in delivering clay from the Cliffe marshes—about ten miles down river—to works at



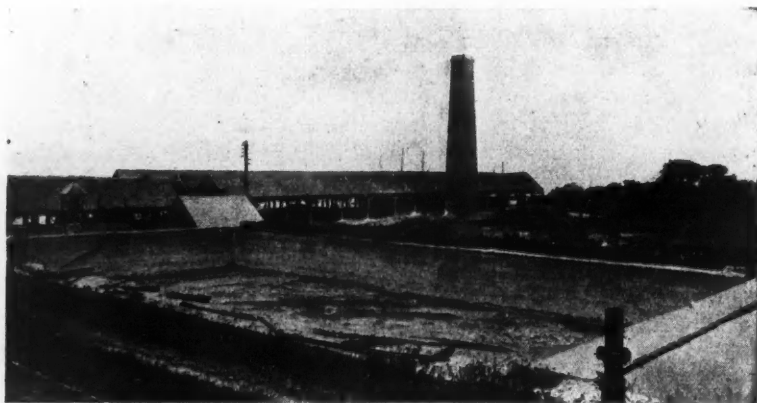


Fig. 10.—A Slurry "Back" of 1897.

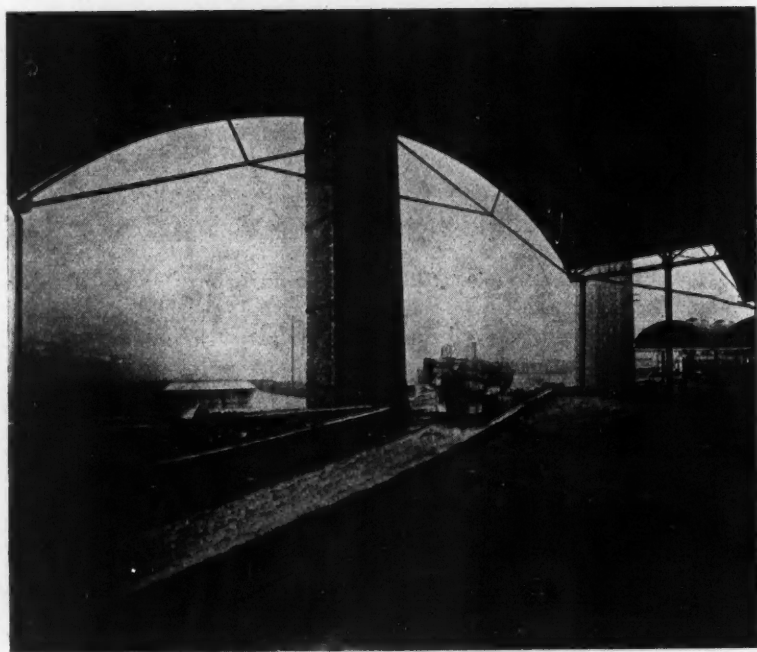
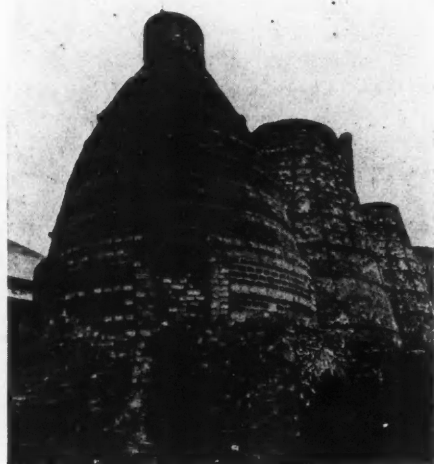


Fig. 11.—A Drying Floor for Slurry (1897).



Greenhithe. In this case the clay is inside the sea wall and therefore not tidal. The pit is, however, not pumped out, and both the crane and the washmills are carried on a pontoon; the combined plant is shown in *Fig. 8*. This arrangement has the great advantage that the clay is delivered directly to the washmill by the crane and grab by which it is dug. The clay slurry is pumped ashore through flexible pipes carried on floats to storage tanks on the river bank. From there it is again pumped into tank vessels each holding about 1000 tons of slurry, equivalent to about 1000 tons of cement. On reaching the works the slurry is again pumped from the vessels into storage tanks on the river bank, and it is pumped a fourth time to the main washmills where the chalk is added. *Fig. 9* shows a tank vessel.



**Fig. 12.—Bottle Kilns (1897).**

The transport of clay is one of the outstanding examples of mechanisation, and the modern systems illustrated show enormous savings of labour. The washmills in use to-day are exactly similar in principle to those used fifty years ago, the only changes being the larger size of the mills and the greater power required.

The steps involved in handling the slurry after it left the washmills at Bevens in 1897 were: (1) Pumping into "backs," that is large shallow tanks similar to those commonly used in making stock bricks. Such a back is shown in *Fig. 10*. At this stage the slurry had about 60 per cent. of water, and after settlement the excess was drawn off, leaving a "pug," or "slip," with about 30 per cent. of

water. This process took several months, but it had the advantage that it provided a certain amount of mixing and also allowed large particles of chalk, which in those days often escaped the wash-mill sieves, to settle. They could then be left when the "back" was dug out. (2) This pug was excavated from the "backs" by hand just like marsh clay and delivered in narrow-gauge trucks to drying floors similar to that shown in *Fig. 11*, which were heated by the waste gas from bottle kilns (*Fig. 12*). (3) The dry slurry was dug from the drying floors by hand, barrowed, and placed in the kilns by hand with alternate layers

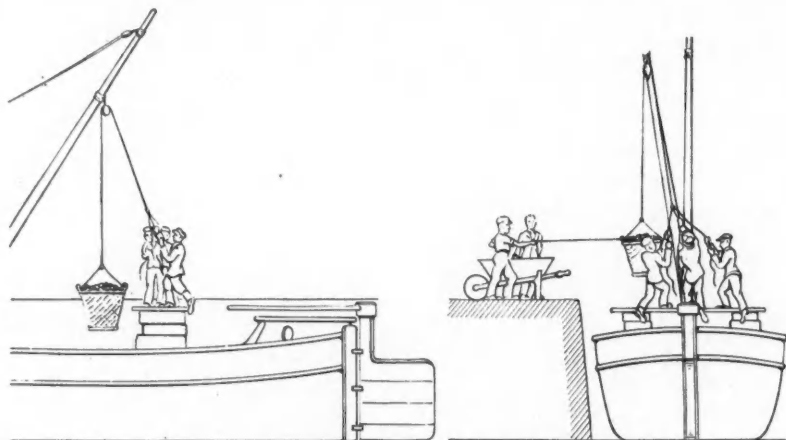


Fig. 13.—Unloading Coke Fifty Years Ago.

of coke. (4) After withdrawing the fire bars, the kilns were unloaded by hand and the clinker barrowed to the grinding mills. It was not then the practice to store clinker, and the mills were operated to suit the drawing of the kilns.

These four separate handlings compare with the practice to-day, which is as follows. The slurry is washed in as thick a state as practicable (that is with about 40 per cent. of water) and pumped into tanks. In some cases deep tanks are used and periodically agitated by compressed air, thus ensuring thorough mixing and giving the chemist complete control of the carbonate content of the slurry. From these tanks the slurry is withdrawn into shallow tanks for storage, where it is agitated by mechanical stirrers or compressed air. From these it is pumped directly into the kiln. The clinker is discharged from the coolers directly on to conveyors leading to bins over the grinding mill, or into storage bins, as the case may be. Thus three separate handlings of the slurry and one of the clinker are entirely eliminated.

#### Handling Fuel.

Until the introduction of the rotary kiln all kilns were intermittent and burned coke, which, in the Thames and Medway area, came almost entirely from the

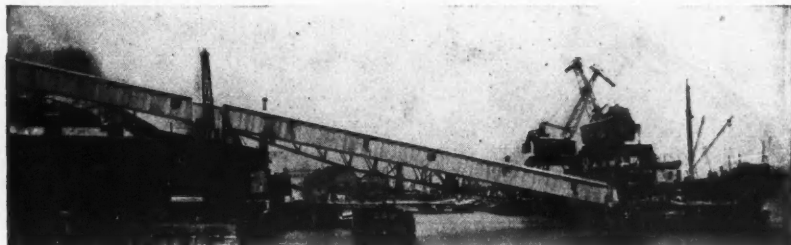


Fig. 14.—Conveying Coal from Ship to Shore (1947).

London gas works and was transported to the cement works in sailing barges. At Bevans works it was unloaded by hand. The coke was shovelled into baskets, a steel plate being pushed into the coke to facilitate the entry of the shovel, and the baskets were hoisted by a rope running over a pulley carried on a strap fixed to the sprit. This rope was trifurcated and hoisted by three men who stood on a raised plank; as they pulled on the ropes they stepped down from the platform on to the deck so as to secure a longer hoist and so that the weight of their bodies would help to raise the basket; the method is indicated in *Fig. 13*. The man who emptied the basket into the barrow pulled it over by a separate rope. The buckets were tipped into barrows which were wheeled to the store. From here the coke was again shovelled into baskets and hoisted by hand to the eyes of the kilns.

The fine coal used in the rotary kilns is nowadays unloaded directly from steamers by electric grab-cranes and taken entirely by belt conveyors to the



Fig. 15.—Filling Wooden Casks in the last Century.

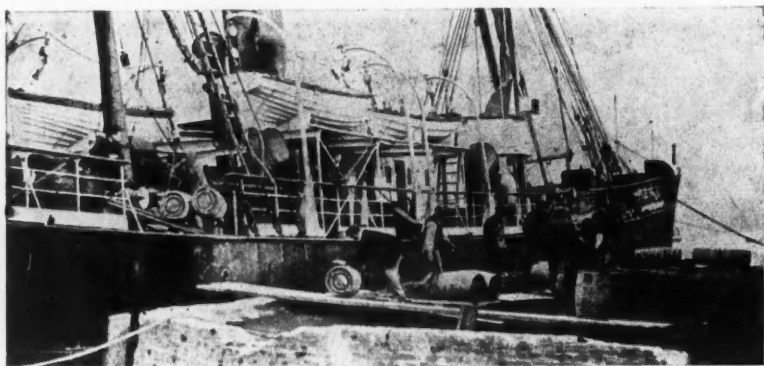


Fig. 16.—Rolling Casks to a Ship Fifty Years Ago.

store (*Fig. 14*) and again from the store to hoppers over the coal-grinding mills.

#### Grinding Mills.

For an output of 1,700 tons a week in 1897 there were five grinding mills with a total of thirty pairs of millstones. These were dressed by hand every few days by hand hammers and pritchels, a most laborious job. In 1903 the stones were replaced by ball mills and tube mills installed in the same buildings and driven by the same steam engines. In 1924 the grinding mills were all compound mills and were concentrated in a building close to the kilns.

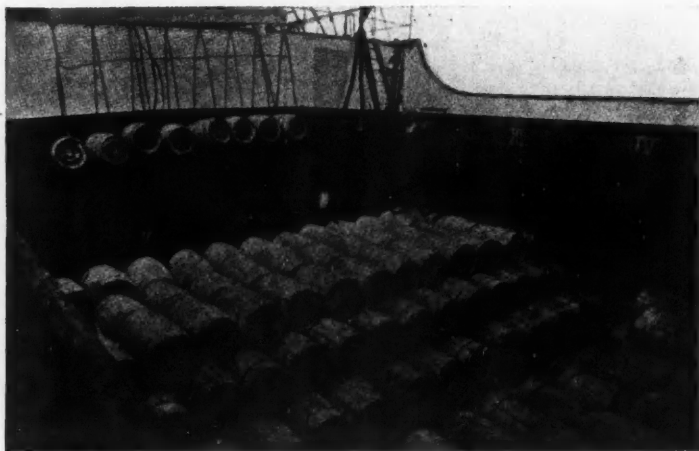


Fig. 17.—Handling Casks Eight at a Time (1947).



Fig. 18.—Handling Jute Sacks (1947).



Fig. 19.—Lifting Cement in Paper Bags by Crane (1947).

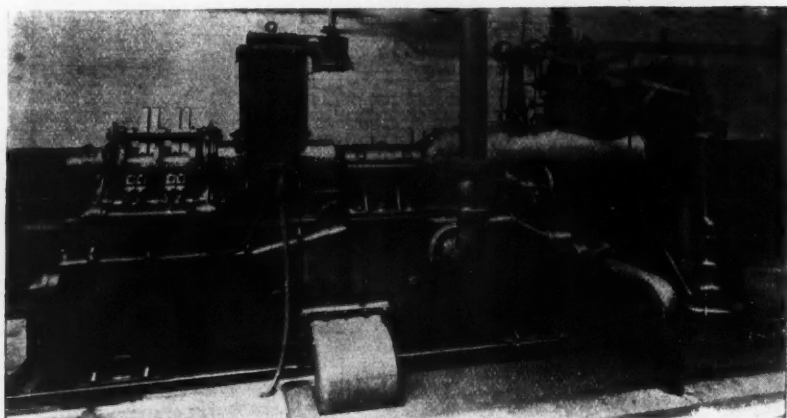


Fig. 20.—A 75-KW. Turbo-Generator Installed in 1899.

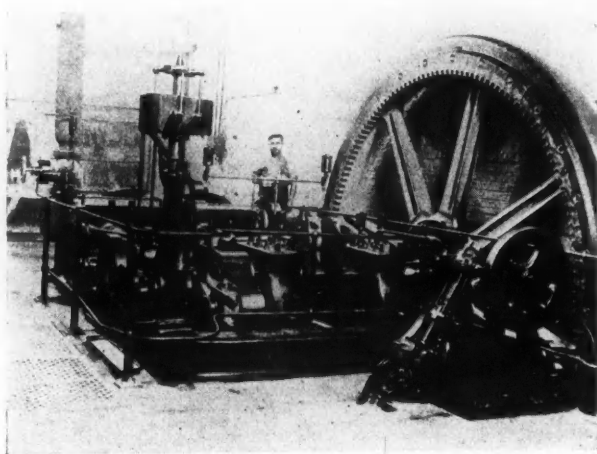
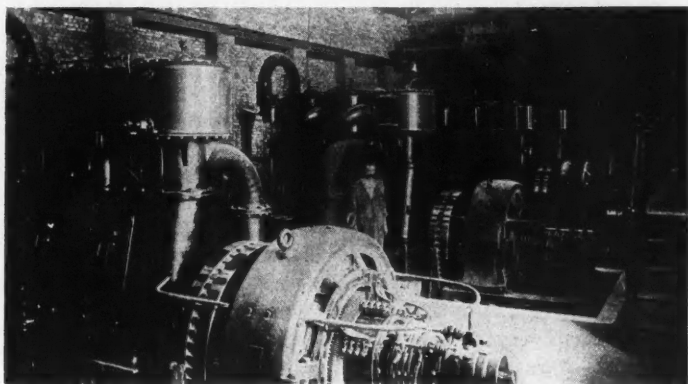


Fig. 21.—Steam Engine used up to 1924 for Driving Washing and Grinding Plant.

### Packing.

The cement was stored entirely in warehouses and the bags and casks were filled from the toe of the heap entirely by hand.

Bevans works has always been used very largely for export trade. In the old days cement for export was packed in wooden casks. The filling of the casks is shown in *Fig. 15*. The casks were rocked by hand to consolidate the cement—quite a skilled job; this was important, as a loosely filled cask was structurally weak and therefore easily damaged. The casks were canted on to the weighing machines, and then pushed over and rolled to the loading point, where they were loaded singly or in pairs (*Fig. 16*). The platform from which this took place had to be above the side of the barge—no cranes being then employed—so rolling was often uphill. They are now loaded into ships at any state of the tide, eight at a time, as shown in *Fig. 17*.



**Fig. 22.—Steam Engines used for Generating Electricity up to 1924.**

At that time sacks were always of jute and held from 200 lb. to 224 lb. They also were filled by hand, trotted on barrows, and slid into barges down a chute, their speed being checked by a hinged side being pressed inwards by one of the gang sitting down and using his foot. This job was taken by members of the gang in turn, and was a rest from filling the sacks and trotting with the barrows.

Paper sacks afford much better protection against the weather than jute, and had replaced casks for most markets until the post-war shortages resulted in the use of whichever material is available. When necessary steel drums are used, and these are filled on weighing machines, jogged mechanically to ensure consolidation, and the heads are put on by a vertical rolling machine. Paper bags are now provided with valves and filled by machines with an automatic cut-off to secure correct weight. Sacks are delivered by a belt conveyor to a turntable and stacked on them by hand with the rope slings already in place (*Fig. 18*). The turntable is slowly turned by press button control as stacking proceeds, and one man can comfortably cope with 40 tons per hour. The loading



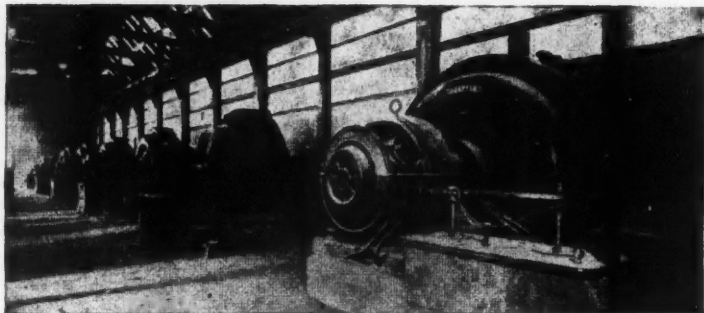


Fig. 23.—Motors for Driving Compound Mills (1947).

crane picks the slings directly off the turntables and for traffic in lighters on the Thames and on coastwise shipping the slings are left round the sacks, thus saving labour when unloading. Paper bags are generally stacked on wooden platforms and hoisted by crane (*Fig. 19*).

#### Electrification.

The first electrical generating plant at Bevans works was installed in 1898 and consisted of a 25-kw. two-pole dynamo belt-driven from an open-type vertical marine engine. This was used chiefly for arc lights in the quarry and wash-mill yard and on the wharves. These proved a great advantage—although they needed a lot of attention!—but the advantages of motor drives for small auxiliary machines were soon appreciated and in 1899 a Parsons 75-kw. direct-current turbo-generator was installed. A very similar machine is illustrated in *Fig. 20* and is interesting as a very early type. The turbine and dynamo were mounted on the surface condenser, which stood in an oil tray. The air and circulating pumps were driven by a worm gear from the end of the turbine spindle, and these were the only parts bolted down to the foundation. The steam was admitted in "puffs" by a valve operated by a cam on the pump shaft, the lift being controlled by a solenoid with a centrifugal governor as a safety measure. This proved a most satisfactory unit, and sufficed until rotary kilns were installed in 1904.

Up to 1924 the washing and cement grinding plants at Bevans were driven by nine steam engines each in its own engine room. These averaged about 450 h.p. each—a typical engine is shown in *Fig. 21*. The kilns, the coal-grinding plant, and the auxiliaries were driven by direct-current electric power generated by four 400-h.p. Bellis engines shown in *Fig. 22*. A turbo-generator was added later. Each plant had its own driver, stoker, and coal wheeler.

In 1925 electric driving was adopted throughout, and about 6,000 kw. are purchased annually from the County of London Company's generating station at Barking. The six old individual cement grinding plants were superseded by seven compound mills in one building. The motors for a similar installation at a neighbouring works are shown in *Fig. 23*. The enormous saving in labour is obvious.

---

## The Chemistry of Non-Shrinking and Expanding Cement Pastes.

IN our number for January, 1947, we described some of the physical properties and applications of some special cements developed in France. In the following, which is abstracted from a paper read by M. E. Perre in Paris in 1943, further particulars are given relating to the manufacture and the chemical composition of these cements, which are made so that the pastes upon setting exhibit either expansion or no volumetric change. The name of M. Junnemann is associated with these cements which have been made in the laboratories and works of Messrs. Poliet and Chausson.

Experiments on expanding cements date from 1932. As described in our previous article, the main constituents are Portland cement of normal composition and a sulphoaluminate cement, the composition of the latter being adjusted to give the required results.

Sulphoaluminate cement is manufactured commercially from a slurry prepared from a mixture containing 50 per cent. of gypsum, 25 per cent. of red bauxite, and 25 per cent. of chalk. The preparation is made difficult by the fact that the gypsum and the bauxite tend to separate in the slurry. The fineness is such that less than 2 per cent. is retained on a sieve of 900 meshes (French series). The slurry contains 42 to 45 per cent. of water and is burnt in a coal-fired kiln of about 10 ft. 6 in. diameter by about 230 ft. long. Clinkerisation occurs at a temperature substantially below that associated with Portland cement. The material forms in the kiln into balls of about 20 in. diameter which break down upon cooling. The clinker is blue-grey in colour, is very dense, and has a crystalline fracture. A faint odour of sulphurous gas is perceptible, and analysis shows that the clinker contains one gramme of  $\text{SO}_3$  per cubic centimetre. After cooling the clinker is broken up and ground.

In laboratory tests, sulphoaluminate cement was prepared in a kiln fired with gas-oil, a temperature of 1250 to 1300 deg. C. being attained in two hours and maintained for half an hour. Clinkerisation commenced at about 1250 deg. C. and fusion at 1300 deg. C. The clinker, although hard, was brittle.

Sulphoaluminate cement is more readily attacked by pure water than Portland cement, but exposure in an atmosphere saturated with carbonic acid gas, which is generally particularly injurious to cement, does not seem to affect the strength. Sulphoaluminate cement is extremely sensitive to the presence of free lime, a small quantity of which is sufficient to cause disintegration.

In addition to the Portland cement and the sulphoaluminate cement, which when mixed together form the basis of non-shrinking and expanding cements, there is a third constituent the purpose of which is to control, and after a given time to arrest, the expansion by absorbing the principal re-agent, namely, the calcium sulphate. Blastfurnace slag is commonly used for this purpose. Careful propor-

tioning of the three constituents enables the intensity and duration of the expansion to be controlled. The mixture must be made with great care because any irregularity seriously affects the results.

Generally, an increase in the proportion of sulphotoaluminate cement increases the amount of the expansion, which is a function of the amount of  $\text{SO}_3$  in the mixture. Pastes of expanding cements made in accordance with the procedure described exhibit, upon hardening, an appreciable expansion without disintegration; the slower the expansion, the greater is the resistance.

The importance of the content of  $\text{SO}_3$  is borne out by several series of tests. In one of these the same sulphotoaluminate cement was mixed with Portland cements obtained from different districts. The variation in expansive properties for a given percentage of  $\text{SO}_3$  was little affected by the composition of the Portland cement. In these tests, the proportion of silica in the Portland cements varied from 21.9 per cent. to 24.4 per cent., lime from 61.8 per cent. to 64.6 per cent., and  $\text{SO}_3$  from 1.8 per cent. to 3 per cent.; the compressive resistances at seven days varied from 220 kg. per square centimetre to 350 kg. per square centimetre.

In spite of their expansive properties these special cements have the general qualities of Portland cement. Setting is a little slower, final set taking place generally from eight to ten hours after mixing with water. Curves of the comparative strengths were given in our previous article. Owing to the excess of  $\text{SO}_3$  there is a greater liability of attack by sulphates than with Portland cement.

One explanation of the phenomenon of, and the reactions causing, the expansion is as follows. Portland cement is essentially composed of calcium-silicate, calcium-aluminate, and calcium-aluminoferrite, and among other substances it contains gypsum. Sulphotoaluminate cement contains, in combination or otherwise, calcium sulphate, aluminate, and some silicates in small quantities. The mixture of these two cements in contact with water results in the immediate precipitation of tetracalcium-aluminate,  $\text{Al}_2\text{O}_3 \cdot 4\text{CaO} \cdot 12\text{H}_2\text{O}$ , which gives, under the action of the calcium sulphate in solution, the formation of the expanding calcium-sulphotoaluminate a fine powder,  $\text{Al}_2\text{O}_3 \cdot 3\text{CaO} \cdot 3\text{SO}_4 \cdot n\text{H}_2\text{O}$ .

The anhydrous silicates progressively-hydrate, liberating the lime which forms new quantities of tetracalcium-aluminate which in turn leads to additional expansion. The phenomenon is thus produced in a progressive manner, and only ceases when all the available sulphate has been transformed into sulphotoaluminate. At the same time the aluminate contained in the sulphotoaluminate cement enters into solution and reacts on the calcium sulphate in solution to give, this time without expansion, calcium-sulphotoaluminate, which is easily distinguishable under a microscope because of its crystallisation in the form of long needles.

There is produced therefore a division of the calcium sulphate acting simultaneously on the solid tetracalcium-aluminate and on the bicalcium-aluminate in solution. The latter reaction appears only to be possible because of the small quantity of lime that is slowly liberated by the hydration of the silicates.

The hardened cement paste therefore contains (i) hydrated calcium-silicate,  $\text{SiO}_2 \cdot \text{CaO} \cdot 2.5 \text{H}_2\text{O}$ ; (ii) crystallised hydrated calcium-sulphotoaluminate,  $\text{Al}_2\text{O}_3$ .

$3\text{CaO} \cdot 3\text{SO}_4 \cdot \text{Ca} \cdot n\text{H}_2\text{O}$ ; (iii) hydrated calcium-sulphoaluminate as a fine powder; (iv) an excess of tetracalcium-aluminate,  $\text{Al}_2\text{O}_3 \cdot 4\text{CaO} \cdot 12\text{H}_2\text{O}$ ; and probably (v) some uncombined lime liberated by the hydration of the silicates.

---

## The Cement Industry in Britain.

### REPORT OF COMMITTEE ON CEMENT COSTS.

A COMMITTEE appointed by the Ministry of Works in 1945 to review the financial structure of the British cement industry, with particular reference to the prices charged, has now issued its report (copies may be obtained from H.M. Stationery Office. Price 9d.). The committee found that the primary function of the Cement Makers' Federation is the fixing of prices. Prices are fixed by voting on the part of the members, the voting power of each firm or group varying each year according to the quantity of cement delivered in the preceding year. The voting rights are weighted in such a way that the number of votes does not increase automatically in proportion to the increase of deliveries. No decision can be taken without the support of at least four members or groups. The expenditure on research incurred by the Federation has not been large, although it has been supplemented by research conducted by the separate companies. The Federation recently endowed a Chair of Concrete Technology at the Imperial Institute and it is understood that it is intended that in future a substantial expenditure on research should be initiated by the Federation. The deliveries of cement in the year 1925 were 3,754,000 tons, and this steadily increased to a maximum of 8,252,000 tons in 1939. During the same period, exports varied from 525,000 tons in 1935 to 1,092,000 tons in 1929. During and since the war the annual production was 7,190,000 tons in 1940, 7,143,000 tons in 1941, 7,260,000 tons in 1942, 6,970,000 tons in 1943, 4,560,000 tons in 1944, and 4,070,000 tons in 1945. In those years the quantities exported were 424,000 tons in 1940, 369,000 tons in 1941, 259,000 tons in 1942, 242,000 tons in 1943, 440,000 tons in 1944, and 767,000 tons in 1945.

Details are given of the prices charged and rebates given to different classes of customers. Since 1939 changes in the price of cement have been made with the approval of the Government, since when the industry voluntarily accepted Government control over its selling prices. The increases since 1939 do not exceed 48 per cent.

On the capital employed in the industry the profits of the companies on cement and ancillary activities were  $10\frac{1}{2}$  per cent. in 1938, 12 per cent. in 1943, and  $6\frac{1}{2}$  per cent. in 1945. In the opinion of the committee these profits were reasonable, and the price of cement, judged by the profit made, was not unduly high in 1938 or since.

The committee summarises its conclusions and recommendations as follows:

(a) The Cement Makers' Federation embraces all manufacturers of cement

in the United Kingdom and fixes prices to which all those manufacturers conform. There exist within the Federation nine independent financial interests and the industry is therefore not a monopoly in the sense of being under one single financial control.

(b) The price structure of the industry is founded on a minimum price scheme and on a quota arrangement which first became effective in the year 1934.

(c) The profits earned by the industry in the past have not, by reference to capital employed, been excessive.

(d) There is no evidence that the Federation has abused its position. The quality of the product has been improved since the formation of the Federation, and the industry has in the past uniformly succeeded in meeting the demand. The Federation has not exercised its control for the sake of restriction of output, but has continually sought additional outlets for its manufactures.

(e) The price system as a system is not an unsound one, nor in its intention does it work injustice on the consumer. But we consider that, as the Federation has control of prices for the whole industry, it should accept a greater measure of responsibility than it has in the past for the efficiency of the works of its individual members. In this connection the Federation should consider setting up an arrangement which would enable it in the first place to review production costs to ensure that the retention of a particular works whose costs of production are high is, in all the circumstances, essential, and so as to make possible dissemination of cost information which, without disclosing to one firm the actual cost figures of another, should yet provide member firms with a yardstick by which to judge their own costs in relation to the experience of the industry in general.

(f) As competition on price has, through the working of the quota agreement, been eliminated except for special cements, we consider that, when the existing price controls are withdrawn as regards this industry, the Federation should, nevertheless, be prepared to submit its price schedules to an independent body appointed for the purpose. Consultations with such a body should be held at appropriate but not too frequent intervals.

(g) The price level which is right at any particular time must be arrived at by reference to an appropriate assumption of costs of production and of output levels. In the committee's view, the time for a general review of prices may well have arrived, but in making this suggestion the committee does not intend to forecast whether as the result of it present prices will be maintained or whether they will be altered. The committee's view is limited to the finding that the present time is an appropriate one for this subject to be studied with reference to the future price level.

(h) There is a comprehensive system of rebates and sufficient bargaining power between the manufacturers and those interested in the rebates to make it right to leave these matters for adjustment between the interested parties. We have no evidence of price discrimination as between one customer and another, and the basis upon which rebates to merchants and other special categories of customers are granted is well defined and available to those concerned.

(i) The constitution of the Federation presents considerable difficulties to any outside interest establishing new works in this country independently of membership of the Federation. There is no evidence that in the past the Federation has misused its position in this respect and there are arguments against the existence of independent producers who obtain the advantages which follow from the existence of the Federation without conforming to the obligations imposed by membership of it.

#### **The Associated Portland Cement Manufacturers, Ltd.**

In his statement accompanying the accounts of the Company for the year 1946, Mr. George F. Earle (the Chairman) said that the group increased its production of cement in 1946 by 80 per cent. compared with 1945. It had been planned to do considerably better in 1947, and but for the coal shortage there was no doubt that they would have succeeded. But up to the present (May) they had no definite information about the supplies of coal they would have this year. It was a strange state of affairs when the only answer one could give to the question: "How much cement shall we make in 1947" was "We do not know." In 1946 the consumption of cement in the home market increased by 62 per cent., while the quantity and value of the Company's exports were a record in its history. The increase in production produced economies in cost sufficient not only to cover increases in the costs of labour, transport, and materials, but made possible a reduction in the price of cement of 2s. a ton on November 1 last.

During the war, at the request of the Ministry of Works, the cement industry operated under a pooling scheme. He was glad to say that this ended on December 31, 1945. Under the pooling scheme the Company's selling prices in 1945 were subsidised to the extent of 1s. 6d. a ton from reserve funds in the pool, built up in the earlier years of the war. This subsidy ceased on January 1, 1946, so, in effect, selling prices were reduced by 1s. 6d. a ton from that date, while from November 1 last they were reduced a further 2s. a ton, making 3s. 6d. This price reduction was a proof of the Company's declared policy, which was that the proceeds of efficiency should be used first to produce good working conditions and remuneration for employees, and secondly, be shared between stockholders and buyers. The average home trade selling price at works of the A.P.C.M. group in November was only 47 per cent. more than before the war. The output and sales of the Company's other main products—lime, whiting, white cement, cement paint, coloured and water-repellent cements and Cullamix, all showed good increases in 1946, and in spite of the fuel crisis better results were expected this year.

Apart from the coal shortage, the chief factors hindering production were shortages of labour and materials. The latter was mainly outside their control. It was extremely difficult to find labour, especially at works in country districts, owing to the housing shortage, and every effort was being made to get temporary houses built. The only other thing they could do, and were doing, was with the help of their men to improve production per man. Output per man per week was



not yet up to its pre-war standard ; it was now 6.6 per cent. less. One reason why this figure was better than that of many industries was that the factories were very highly mechanised, and during the process of manufacture the materials were never touched by hand until the bag of finished material was loaded into transport. They were, wherever possible, installing machinery to make the labour force more productive.

Oil-burning equipment was being installed at two of their works, and if it was possible to purchase oil at a reasonable price it was probable that this programme would be extended. Fuel and power accounted for 53 per cent. of the works cost of making cement. They had suffered considerably from the lower quality fuel which they had to use. If in pre-war days colliery companies had sent coal of the quality sometimes now received it was certain that those companies would receive no further contracts, but now they had to take what they were given and do the best they could with it. The calorific value of the coal obtained in 1946 was 6 per cent. lower than in 1939. This meant that they paid for 74,000 tons of valueless material, and for this rubbish they paid £176,000. The Works Department was to be congratulated on the fact that coal consumption, based on calorific value, showed a reduction of 6.85 per cent. on the pre-war figure.

Last year he reported that the programme of new works involved an expenditure of over seven million pounds. This programme had been pushed forward with much energy, but in these days the amount of progress was not in direct ratio with the amount of work done. Everyone knew what a lot of time was wasted nowadays in getting permission to do things ; this especially applied to building new works, and the amount of time and money which must be spent before a start could be made was frightening. When the needed permissions and licences eventually were procured, and the orders placed, the passing of time often put the delivery dates farther into the future. Under these conditions it was not surprising that progress was slow. However, he believed that if they got the coal they needed the new works and extensions of works would be producing in time to meet the expected increase in demand.

Reading the chairman's speeches after the last war, one was impressed by the fact that the then post-war conditions had similarity with present conditions. The difficulties, however, were less severe and there were basic differences. In those days the Government believed that the proper people to run industry were the trained industrialists, and the incentive-killing effects of nationalisation and penal taxation were not present. There was another great difference, which he thought could be best expressed by saying that nowadays many people seemed to have a greater belief in fairies than they did after the last war. Now some seem to think that the goods they needed could be produced by working less hard instead of harder, so they must believe that a good fairy was going to help.

The overseas companies in which they were interested all did well in 1946. In Mexico they had started to build a new works which would have a capacity of 300,000 tons per annum. When this works was finished, the total annual capacity of the companies there would be 700,000 tons. It had been decided that residents



in Mexico should be given an opportunity of having a share in the Mexican companies and this transfer was now proceeding. In South Africa they were starting the erection of a new works at Lichtenburg. In Canada the British Columbia Cement Co., Ltd., had had a satisfactory year, and had tentative plans for an extension of output. They had examined the advisability of erecting a cement works in Jamaica, and had come to the conclusion that such an investment was not desirable at present. They were in close touch with several other countries, and hoped that it would be possible to erect further overseas works.

In his address to the shareholders Mr. Earle said that the industry had welcomed the decision of the Ministry of Works to set up the Committee on Cement Costs, and had decided to adopt all its recommendations. He also mentioned that it seemed likely that the supply of fuel would be considerably improved in the second half of the year.

---

### Tests on Clinker Grinding in Belgium.

A RECORD of some experiments on clinker grinding that have been in progress since 1931 at a cement works in Belgium is given in "Rock Products," September 1946. The conclusions from these tests include the following.

For clinker having a maximum size of 4 in., balls of not less than 80 mm. diameter should be used. For clinker up to  $\frac{3}{4}$  in. the best yield of cement having a residue of 60 per cent. on a sieve with 178 meshes per inch is given by balls of mixed sizes ranging from 30 mm. to 60 mm. in diameter. If a residue of 50 per cent. is required, the average sizes of the balls should be smaller. When grinding a product having a residue of 60 per cent. down to a product having a residue of 20 per cent., balls of 20 mm. diameter give the best result, although a mixture of balls of different sizes but having the same specific surface gives almost as good results.

In finish grinding down to a residue of 2 per cent., 10 mm. cubes are preferable. These cubes weigh about  $7\frac{1}{2}$  grammes each, that is, about 160 cubes weigh 1 lb.

The most effective speed of rotation of the mill in revolutions per minute is given by the expression  $\frac{58}{\sqrt{D}}$ , where  $D$  is the diameter of the mill in feet. In practice there is a tendency to operate at about 85 per cent. of this speed in order to reduce power consumption, and the output of the mill is correspondingly reduced. In one experiment, at a speed to 64 per cent. of the most effective speed of 39 r.p.m. for a particular mill, the output of the mill was reduced to 55 per cent. of the output at the optimum speed. By increasing the speed to  $12\frac{1}{2}$  per cent. above the most effective speed output was also reduced, in this case to 86 per cent.

The volume of the charge of clinker should be about 30 per cent. of the volume of the mill. The shape of the grinding media appears to be of secondary importance.

---

**Cement Packed in Cotton Bags.**

OWING to the scarcity of paper bags, British cement makers have bought large quantities of cotton bags. The Ministry of Works has agreed that cotton bags be charged at 3s. 4d. net each and credited at 3s. net on return on the same terms and conditions which apply to jute sacks. The Ministry of Works has also agreed that it is fair to include a proportion of the high cost of cotton bags in the charge for paper bags, and has authorised an increase of 2s. in the charge for paper bags per ton of cement (from 7s. to 9s. per ton of cement). When cement is supplied in paper bags in quantities of less than one ton the bags will be charged at 6d. each. The use of cotton bags and these new charges came into operation on July 1, 1947.

**Imitation Cement in Germany.**

IMITATION cements have been made in Germany during recent years. One is produced by mixing four parts of burnt dolomite with one part of blastfurnace slag. The mixture is finely ground and then hydrated in a plant used for making white lime. It is claimed that the cement can be used for mortar for rendering as a cheap substitute for Portland Cement.

Another type of cheap cement said to be suitable for the same purpose is produced by mixing ground blastfurnace slag with hydrated lime or ground lime. In one process the ground lime and the pulverised blastfurnace slag are ground together in a ball mill and subsequently hydrated. Alternatively, a mixture containing 35 per cent. of finely-ground blastfurnace slag and 65 per cent. of hydrated lime is sold in paper bags.

**BOOKS ON CONCRETE**

For a list of  
"CONCRETE SERIES"  
books on concrete  
send a postcard to

**CONCRETE PUBLICATIONS LIMITED,**  
**14, Dartmouth Street, Westminster, S.W.1.**

**MISCELLANEOUS ADVERTISEMENTS****SCALE OF CHARGES.**

*Situations Wanted, 1½d. a word; minimum 3s. 6d.  
Situations Vacant, 2d. a word; minimum 5s.  
Box number 6d. extra. Other miscellaneous  
advertisements, 5s. minimum.*

**Advertisements must reach this office by  
the 5th of the month of publication.**

**WANTED.** Engineer to take charge of erection of cement factory in Africa, with prospect of subsequent management. Applications confidential. Box 2108, Cement and Lime Manufacture, 14, Dartmouth St., Westminster, S.W.1.

**DERBYSHIRE LIMESTONE QUARRY** ripe for development, centrally situated Peak district. Good road and frontage; deep face, light overburden, low royalty, long lease, by acreage. Newly-built lime kiln, electricity and other facilities included. Not working now—no other plant on site. Advertiser with lease, and quarry experience, seeks interested party with capital and also preferably sales connections. Proposal being to develop burnt lime, monumental stone, and/or fine grinding, as material eminently suits these products. Plentiful fuel supply arranged. Capital from £10,000 upwards only of interest, for a 50 per cent. to 80 per cent. holding with quarry manager advertiser. Alternatively would sell interest. Box 2108, Cement and Lime Manufacture, 14 Dartmouth Street, Westminster, S.W.1.